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HOME RANGE OF BREEDING COMMON RAVENS IN COASTAL SOUTHERN CALIFORNIA

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The largest remaining nesting colonies of the endangered California least terns (*Sterna antillarum browni*) are located on Camp Pendleton, a military base in coastal southern California (L. A. Belluomini, in litt.). Recently, United States Naval biologists identified common ravens (*Corvus corax*) as potential serious predators on eggs of these birds (L. A. Belluomini, in litt.). However, no quantitative data are available on the ecology of common ravens in relation to nesting California least terns. During May and June 1989, we determined if home ranges of radio-tagged common ravens included a relatively small colony of least terns.

The primary study area (66 km^2) was centered on the Aliso Creek least tern colony (4 ha) at Camp Pendleton in northwestern San Diego Co., California. From 5 May to 10 June, we captured one fledgling and 21 adult ravens between 0.5 and 6.5 km from the colony. Thirteen birds were captured with modified Australian crow traps, 7 with cannon nets, 1 with dho gaza, and 1 with a padded steel jaw trap (Bloom, 1987; Engel and Young, 1989). Live decoys were used to lure ravens into drop-in traps and within range of the cannon nets. No captures were made within 0.5 km of the colony to preclude ravens associating capture with the colony.

The fledgling and 20 adult ravens were fitted with radio-transmitters, which weighed about 11

TABLE 1—Home-range (in kilometers squared) estimates calculated from telemetry data obtained from 12 nesting common ravens using Camp Pendleton, San Diego Co., California, May and June 1989.

Bird number	Sex	Number of observations	95% harmonic mean activity area	Minimum convex polygon	95% ellipse	Median
03	Male	35	2.80	4.4	7.10	4.40
04	Male	43	0.60	0.3	0.30	0.30
05	Male	52	1.30	1.2	1.60	1.30
27	Male	25	1.80	1.6	3.60	1.80
29	Male	17	1.20	1.7	6.00	1.70
06	Female	50	1.70	1.4	4.80	1.40
07	Female	31	0.80	0.6	1.60	0.80
08	Female	45	3.50	3.0	3.80	3.50
14	Female	38	0.03	0.4	0.04	0.04
17	Female	27	1.00	0.8	1.30	1.00
21	Female	7	0.80[1]	0.2	1.40	0.80
28	Female	21	0.80	0.4	1.20	0.80
Median		33	11.10	1.0	1.60	1.20
Range		7–52	0.03–3.50	0.2–4.4	0.04–7.10	0.04–4.40

[1] Only a 75% contour could be calculated due to outliers and few observations.

g and functioned for the duration of the study (2 months). Transmitters were attached to the middle two rectrices with hot-melt glue and four nylon laces (Fitzner and Fitzner, 1977). All radio-tagged ravens were marked on the left wing with a numbered, 6.4-cm (2.5-inches) white, patagial marker (Young and Kochert, 1987); a numbered, white, leg band was placed on the right leg and a United States Fish and Wildlife Service band on the left leg.

Sex of adult birds was determined by presence or absence of an incubation patch. Birds were aged as hatching year, second year, or adult (>2 years) according to Kerttu (1973). All birds were weighed to the nearest gram with a spring scale.

From 5 May to 28 June, we located radio-tagged nesting birds in varying order one to two times during daylight hours. Sixty-four percent of the relocations were in the morning. Of these, 41% were between 0700 and 0900 h and 32% between 0900 and 1100 h. In the afternoon, relocations were evenly distributed between 1300 and 1900 h (range of 3 to 8%/h). Birds that moved outside the primary study area after capture were relocated three to four times each week, usually in the morning.

Typically, radio-tagged birds were located from strategic locations using receivers and three-element Yagi antennas from ground vehicles and on foot. Ravens usually were sighted with binoculars, and their locations recorded to the nearest 100 m of a known landmark (e.g., nest site). All relocations were interpolated into the Universal Transverse Mercator (UTM) grid system.

We define "home range" as the area used by a bird during its normal activities, such as foraging, mating, and caring for young (Burt, 1943). We calculated the 95% harmonic-mean activity area (HMAA), minimum convex polygon (MCP), and 95% ellipse (Boulanger and White, 1990), using the MCPAAL computer software package (Conservation and Research Center, Smithsonian Institution).

Kruskal-Wallis test was used to determine if HMAA, MCP, and 95% ellipse home-range estimation methods produced significantly different home-range sizes (Conover, 1980:229–237). Median home-range sizes were compared for statistical significance using Wilcoxon rank-sum test (Conover, 1980:215–218). Spearman rank correlation was used to determine if various estimation methods were correlated and if sample sizes were correlated with home-range size (Conover, 1980:250–256).

Fourteen nests were located within 6.5 km of the tern colony, resulting in 1 nest/4.7 km^2. Six nests were found on cliffs, and six were in trees. We checked nine nests and found an average of 2.9 ± 1.0 (*SD*) nestlings. Ten nestlings were banded in the nest, and one was banded and radio-tagged after fledging.

We obtained sufficient valid data on 18 birds

TABLE 2—Home-range (in kilometers squared) estimates calculated from telemetry data obtained from five non-nesting adult common ravens using Camp Pendleton, San Diego Co., California, May and June 1989.

Bird number	Sex	Number of observations	95% harmonic mean activity area	Minimum convex polygon	95% ellipse	Median
10	Unknown[1]	14.0	22.1	45.8	221.0	45.8
15	Female	8.0	5.1	0.0	5,927.0	5.1
18	Male	5.0	8.2	2.4	65.1	8.2
19	Female	3.0	2.2	9.2	6,687.0	9.2
32	Female	12.0	1.6	2.8	11.3	2.8
Median		8.0	5.1	2.8	221.0	8.2
Range		3.0–14.0	1.6–22.1	0.0–45.8	11.3–6,687.0	2.8–45.8

[1] Morphological measurements indicated that the bird was a male.

for analysis of their home-range sizes. We located 12 nesting ravens, including three pairs, a median of 33 times (range of 7 to 52, Table 1) over a period of 37 days (range of 7 to 54). Five non-nesters were relocated a median of eight times (range of 3 to 14, Table 2) over 25 days (range of 17 to 48). The fledgling was relocated 12 times over 19 days.

The three methods for calculating home-range size (95% HMAA, MCP, and 95% ellipse) produced similar results for the nesting birds ($\bar{X}$ = 3.32, P = 0.1898). The home-range sizes calculated with these methods were significantly and positively correlated with each other (r range of 0.84 to 0.93, P range of 0.0001 to 0.0006), but not with sample size (r range of 0.06 to 0.25, P range of 0.44 to 0.86). Median size of home ranges did not differ between nesting males and females (median = 1.2 km^2, range of 0.04 to 4.4, Z = 1.14, P = 0.2523).

We observed that a female (no. 14) was usually sitting on or near her nest when located, resulting in a median home range of only 0.04 km^2. One male raven (no. 29) was consistently located 300 to 500 m from his nest site, resulting in the nest falling outside his calculated home range.

Smith and Murphy (1973) determined that four pairs of ravens in Utah used an average home range of 6.6 km^2 during the breeding season. Craighead and Craighead (1956) reported that three pairs of ravens in Wyoming maintained home ranges averaging 9.4 km^2. The smaller home ranges used by ravens on Camp Pendleton may be related to the high nesting density along coastal southern California (Robbins et al., 1986).

In two instances, the home ranges of nesting pairs overlapped (i.e., nos. 05 and 21 overlapped with no. 06; nos. 04 and 17 overlapped with no. 28), indicating that ravens nesting in proximity may share portions of their home range. Only one nesting pair (no. 07 and mate) had home ranges that encompassed the tern colony. Their nest was about 400 m north of the colony. An untagged pair of ravens, nesting 1.3 km south of the tern colony, was observed several times feeding just outside the southwestern corner of the colony fence. Since these nesting pairs and their offspring were the only ravens seen near the colony, we speculate that they were defending territories bordered by the tern colony. Others have suggested that ravens defend territories (Smith and Murphy, 1973), although the exact mechanism of maintaining boundaries are not known (Ratcliffe, 1962).

The median home-range size for non-nesting ravens was 8.2 km^2 (range of 2.8 to 45.8; Table 2). After their initial capture, these birds were never located within the primary study area near the tern colony. The MCP method for calculating home-range size produced an area estimate of 0.0 for bird no. 15 because it was always found in the same location, a garbage dump. The fledgling bird foraged with its siblings and used 0.3 km^2 (95% HMAA).

Our data indicate that non-nesting ravens did not visit the Aliso Creek California least tern colony. Indeed, it appears that only ravens nesting adjacent to the colony used the area surrounding the tern colony. The small number of nests (n = 29; L. A. Belluomini, in litt.) may have reduced the attractiveness of the colony as a food source.

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OCCURRENCE OF THE RINGTAIL (*BASSARISCUS ASTUTUS*) IN OKLAHOMA

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Even though Hall (1981) indicated the range of the ringtail (*Bassariscus astutus*) in Oklahoma to include the entire state except for one small area in the northeastern corner and another along the northern edge of the westernmost Panhandle, no documented record appeared on his map. Likewise, the map in Jones et al. (1985) omitted only the northeastern corner. Caire et al. (1990) showed specimen and sight records for several southwestern and south-central counties in Oklahoma, two for the northern tier of counties, and one for the western end of the Panhandle. A majority of these records were based on the 16 specimens deposited in the Cameron University Museum of Zoology (CUMZ) in Lawton and on >60 reliable sight records compiled by J. D. Tyler dating from about 1952 to 1990. However, neither these records nor their provenances have ever been documented in the primary literature. Two additional specimens are in the University of Oklahoma Museum of Zoology (UOMZ) in Norman, two are at Oklahoma State University (OKSU), and another is at East Central University (ECU) in Ada. A skin in the United States National Museum collected by Randolph B. Marcy in 1852 was possibly taken in the Cross Timbers of northwestern Carter County. Most of these locations are in southwestern Oklahoma.